Title

Stress, burnout, depression and work-satisfaction amongst UK anaesthetic trainees; a quantitative analysis of the SWeAT Study.

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Short title

Satisfaction and Wellbeing in Anaesthetic Training (SWeAT) part I: a multi-regional survey

Key words

Anaesthetic training; work stress; work-satisfaction; burnout; wellbeing.

Summary

There is growing evidence that anaesthetic trainees experience, and may be particularly susceptible to, high levels of work stress, burnout and depression. This is a concern for the safety and wellbeing of these doctors and the patients they treat. To date, there has been no in-depth evaluation of these issues amongst UK anaesthetic trainees examining which groups may be most affected and the professional and personal factors which are associated. We conducted an anonymous electronic survey to determine the prevalence of perceived stress, risk of burnout and depression, and work-satisfaction among anaesthetic trainees within South West England and Wales and explored in detail the influence of key demographic, lifestyle and anaesthetic training variables. We identified a denominator of 619 eligible participants and received 397 responses; a response rate of 64%. We observed a high prevalence of perceived stress (37% [95% CI 32 – 42]), burnout risk (25% [21-29]) and depression risk (18% [15-23]) and found that these issues frequently co-exist. Having no children, >3 days of sickness absence in the previous year, ≤1 hour/week of exercise and >7.5hrs/week of additional non-clinical work were independently predictive of negative psychological outcomes. Although female gender was associated with higher stress, burnout risk was more likely in male respondents. This information could help in the identification of at-risk groups, as well as informing ways to support these groups and influence resource and intervention design. Targeted interventions, such as modification of exercise behaviour and methods of reducing stressors relating to non-clinical workloads, warrant further research.

Introduction

Despite high levels of professional satisfaction reported worldwide amongst anaesthetists [1–3], there is growing evidence that a significant proportion, especially trainees, experience considerable levels of work stress, burnout syndrome and depression [2,4-5]. Anaesthetic trainees may be more susceptible to these issues, as the nature of training - with intense work demands, limited autonomy and a high degree of work-home disruption - may put trainees at increased risk [6-7]. Furthermore, pressure for trainees to be successful in postgraduate examinations, to rigorously demonstrate attainment of competencies and to develop a competitive *curriculum vitae*, comes at a time when complaints and negative media coverage of the profession are increasing [8-9].

A large 2013 study of anaesthetic trainees in the United States reported 41% at high risk of burnout and 22% exhibiting signs of depression [4]. In a recent survey of one thousand Australian and New Zealand trainee anaesthetists, 28% of respondents reported high or very high psychological distress scores; major stressors were exams, critical clinical incidents, fear of making errors and concerns about job prospects and workplace-based assessments [10]. In April 2016 UK junior doctors, in response to NHS England's proposed changes to their employment contracts, undertook the first all-out doctors' strike in the history of the NHS. Despite widespread concerns, including from the UK Group of Anaesthetists in Training [11], the new contract was implemented. In December 2016, the Royal College of Anaesthetists (RCoA) circulated a survey of morale and welfare to all anaesthetic trainees in the UK, receiving 2,312 responses (58%). Of the respondents, 85% were in the higher burnout risk category and 61% felt that their work had a negative effect on their mental health [12]. Combined with national data on fatigue in anaesthetic trainees [13], the RCoA published a report in December 2017 making 15 recommendations to individuals, anaesthetic departments and employing organisations, aimed at improving the morale, welfare and experience of UK anaesthetic trainees. However, whilst providing valuable information, this report did not identify specific personal or professional factors that were predictive of negative psychological outcomes in this population.

Concerns are mounting, both for the safety of anaesthetic trainees (impaired concentration; personality change; substance abuse; high suicide incidence [14-15]) and patients (anaesthetic trainees at high risk of burnout demonstrate lower adherence to recommended guidelines and report making more drug errors [4]). There is a pressing need to explore wellbeing issues further and in particular, to better understand which factors influence risk in this group - facilitating the identification of at-risk groups and potential opportunities to manage or modify risk factors.

The current study is the first part of the Satisfaction and Wellbeing in Anaesthetic Training study (SWeAT). We conducted an anonymous survey to determine the prevalence of perceived stress, high risk of burnout

syndrome and depression and work-satisfaction among anaesthetic trainees within South West England and Wales and to explore in detail the influence of key demographic, lifestyle and anaesthetic training variables. This was followed by a series of telephone interviews to study issues and potential solutions in-depth: this is reported separately [16].

Methods

Approvals for the study (IRAS ID 206872) were obtained via the Health Research Authority, Health and Care Research Wales and from Bath Spa University Ethics committee. We designed an anonymous electronic survey consisting of five parts using Online Surveys (Online Surveys, Bristol, UK). Multiple-choice questions were used, with Likert scales used to quantify respondents' levels of agreement with a range of statements. Questions were selected to capture demographic, lifestyle and anaesthetic training variables, where possible supported by evidence, and intended to balance the need for comprehensive data with a manageable survey. Psychological screening tools were used to measure the prevalence of psychological stress (Perceived Stress Scale; PSS-10) [17], burnout risk (abbreviated Maslach Burnout Inventory – Human Services Survey; aMBI-HSS) [18-19], depression risk (Harvard National Depression Screening Day Scale; HANDS) [20], and work-satisfaction (Effort-Reward Imbalance scale; ERI) [21]. All screening tools (detailed in Appendix 1) were selected in conjunction with a psychologist specialising in occupational wellbeing (E.W.). Each tool identified high risk categories and these were used for identifying high risk respondents for each psychological domain (Box 1). The survey was piloted locally to refine the selected questions and to estimate the expected completion time.

(Box 1 near here)

The survey was distributed to all anaesthetic trainees and non-training grade junior anaesthetists (clinical fellows, Trust-grade anaesthetists) working in South West England and Wales via a generic invitation email containing the Participant Information Sheet and a hyperlink to the survey. Consultants and Specialty and Associate Specialist (SAS) doctors were excluded. Survey dissemination was facilitated by the collaboration of three anaesthetic Trainee Research Networks, with identified local leads within each participating anaesthetic department electronically distributing the survey to individual participants. Completion of the survey was taken as a proxy for informed consent, in line with British Psychological Society guidelines on internet-mediated research [22]. Although the survey was anonymous, respondents were invited to provide contact details to enable potential participation with follow-up telephone interviews. The Participant Information Sheet and survey clearly displayed and signposted the support options available for any participant adversely affected by the questions being asked. In addition, the study was formally supported

by the Professional Support Unit within each participating region. The survey was open for four months between March - June 2017. To increase the response rate, the survey was advertised via relevant Schools of Anaesthesia, through participating Trainee Research Networks, via their local leads and using social media. Respondents were also offered the opportunity to enter a lottery prize draw for an Apple iPad Mini on completion of the survey.

To determine the denominator, Trainee Research Network local leads in each participating anaesthetic department identified and reported the total number of anaesthetic trainees and non-training grade junior anaesthetists working there in March 2017. Trainees on maternity leave or working overseas were not included in the denominator. This data was then cross-referenced with data on trainee numbers and demographics provided by each School of Anaesthesia in the participating regions. No formal sample size calculation was undertaken as the survey was designed to include all anaesthetic trainees and non-training grade junior anaesthetists working in South West England and Wales.

The results were analysed using SPSS Version 25.0 (IBM Corp, New York, United States) and Euler diagram (Figure 1) produced using *EulerAPE* Version 3.0 (Micallef L, Rodger P, School of Computing, University of Kent, UK). The proportion of missing data was <1% across each of the variables and therefore there was no attempt to account for missing values in the analysis. Respondents were categorised as being at either high or low risk of stress, burnout, depression, and/or low work-satisfaction using the PSS-10, aMBI-HSS, HANDS, and Effort-Reward Imbalance scales respectively. Respondent characteristics were then compared based on these categorisations with univariate analysis using the Fisher exact test. Statistical significance was recorded when $p < 0.05$. A binary logistic regression was fitted for high stress, high burnout risk, high depression risk and low work-satisfaction to identify significant factors. Only main effects were considered and therefore interaction terms were not included. Significant effects were identified using backwards selection and the Wald test such that variables were removed from the model if removing them did not significantly decrease the fit of the model ($p<0.05$). This commenced with the least significant variable until there were no non-significant variables left to remove. The resulting models are then presented using odds ratios and associated 95% confidence intervals.

Results

We identified a denominator of 619 and received 397 responses to the survey: a response rate of 64.1%. All (29) hospitals with eligible participants contributed to the study with response rates varying from 55.3% to 69.3%. Every respondent replied to all questions. Fifty-two percent of respondents were male. Age groups were: 25-30 (36%), 31-35 (46%), 36-40 (14%), 41-45 (4%) and >45 (0.5%). These sample demographics

approximated reference data held by the Schools of Anaesthesia (54% female, median age 34 yrs (IQR 32-37 [range 26-47]). Respondents' training grades were: Core Training 1-2, including Acute Care Common Stem (38%), Specialty Training (ST) 3-4 (21%), ST 5-7 (27%) and non-training grades (14%). Respondents reported a median of 7.5 hours of non-clinical work per week performed outside of contracted hours (Table 1).

(Table 1 near here)

The prevalence of high perceived stress, high risk of burnout, high risk of depression and low work-satisfaction are presented in Table 2. Within the subscales of burnout, high emotional exhaustion was similar between males (63 of 206; 31%) and females (48 of 191; 25%; p=0.26). Low personal accomplishment was more frequent in females (85 of 191; 45%) compared with males (63 of 206; 31%; p=0.005) while depersonalisation was more common in males (73 of 206; 35%) than females (37 of 191; 19%; p=0.0005). Within the HANDS scale, 2.7% (11 of 397) respondents reported that they thought about wanting to commit suicide at least some of the time - all were in the group of respondents with a HANDS score >9.

(Table 2 near here)

Of those in the high stress category, 44% (65 of 147) were also in the high burnout risk group compared with 13% (33 of 250) in the lower stress group (p <0.0001). Of those in the high burnout risk category, 40% (39 of 98) were also in the high depression risk category compared with 11% (34 of 299) in the lower burnout risk category (p <0.0001). High burnout risk and high depression risk co-existed in 39 of 397 (10%) respondents. High perceived stress, high burnout risk, high depression risk and low work-satisfaction co-existed in 30 of 397 (8%) respondents.

(Figure 1 near here)

Associations of stress, burnout, depression and work-satisfaction with demographic, lifestyle and anaesthetic training variables

(Tables 3-5 near here)

While 47% of all participants completed the survey anonymously, in the groups with high perceived stress, high risk of burnout and of depression, and low work-satisfaction, the proportion reporting anonymously was 70%, 89%, 96% and 65% respectively. In all cases, respondents in high risk groups were more likely to

have reported anonymously and were therefore less likely to be available for potential participation with telephone interviews (see Table 3).

Binary logistic regression models identified several variables independently associated with high perceived stress, high burnout risk and high depression risk (Table 6). Overall, the presence of any one of these risk factors increased the odds of a negative psychological outcome by approximately one and a half to three-fold. None of the variables analysed were significantly predictive of low work-satisfaction following logistic regression.

(Table 6 near here)

Discussion

This is the first study relating psychological stress, risk of burnout and depression, and work-satisfaction in UK anaesthetic trainees to demographic characteristics, lifestyle behaviour and non-clinical workloads.

Thirty-seven percent of respondents reported a high level of *psychological stress,* which is consistent with estimates of moderate-high stress for trainee and trained anaesthetists worldwide [2, 8, 23]. Exposure to stress is unavoidable in anaesthesia practice and in moderate amounts may improve professional performance [8]. However, when stress exceeds an individual's coping mechanisms, there can be adverse consequences and a negative impact on health [2]. Some of these effects can be mitigated by having a high degree of job control, empowerment and professional satisfaction [24]. It is therefore worrying that a substantial proportion of our respondents reported major adverse associations of stress exposure in the form of high burnout and depression risk. Female gender, weekly exercise of $\leq$1hr and >7.5hr/week of non-clinical work were independently predictive of high perceived stress. Higher stress in female anaesthetists has also been reported using alternative assessment tools, suggesting that there is a true gender difference which is not yet fully understood [25].

Trainees reported undertaking a median of 7.5 hours of non-clinical work each week outside of their contracted hours. Workload >7.5hr/week increased the likelihood of high stress almost two-fold. The requirement for trainees to undertake examinations, workplace-based assessments, and to develop their *curriculum vitae,* may significantly increase workload outside of contracted hours - these requirements are consistent stressors for anaesthetic trainees [10, 12, 26]. This supports recent calls for UK anaesthetic departments to provide work schedules which enable personal and professional development, including, consideration of allocating Supporting Professional Activities (SPA) time for trainees [12].

The 25% prevalence of high *burnout risk* we report is consistent with previous values (10-41%) for trainees and trained anaesthetists worldwide, but notably lower than the 85% reported by the recent RCoA survey [12, 27]. This may be because the RCoA survey employed the Oldenburg Burnout Inventory [28] and was conducted closer to the UK junior doctor contract negotiations. Alternatively, burnout rates may vary between UK regions and be notably lower in the regions we studied. Taking >3 days of sickness absence in the previous year, having no children and male gender were independently predictive of high burnout risk. Male respondents reported more personal accomplishment, but substantially higher rates of depersonalisation. Higher depersonalisation scores in male respondents may represent early burnout; whereas female physicians tend to experience emotional exhaustion as the onset of burnout syndrome, male physicians are more likely to experience depersonalisation [29]. Appropriate screening and intervention may play a role in the identification and management of early burnout in anaesthetic trainees [30].

Measures of *depression risk* were high, with 18% of respondents reporting symptoms indicative of a major depressive episode. This puts UK trainees towards the higher end of previous estimates (6-22%) for depressive episodes in anaesthetic trainees worldwide [4, 31] and is almost twice the annual incidence in the UK general population [32]. Eleven (2.7%) respondents reported suicidal ideation within the previous two weeks, which exceeds the age-adjusted 12-month incidence in developed countries (2.0% [99% CI 1.7-2.2]) [33]. Having no children, low rates of exercise and higher rates of sickness absence were independently predictive of high depression risk. This supports previous research which shows that having no children is associated with high risk of both depression and burnout [4, 27]. Parenting may 'humanise' junior doctors, resulting in less detachment and depersonalisation [34], whilst parenthood may also be a surrogate for an effective domestic support system.

Taking >3 days of sickness leave in the previous year was associated with both high burnout risk and high depression risk. This is a new finding and represents an accessible objective risk indicator that holds potential as a trigger to initiate support processes.

Almost half of respondents reported an imbalance in the ratio of experienced occupational rewards compared to efforts. This is a concern as effort-reward imbalance is associated with depression and lower quality patient-care [35-36]. We found no association with increased alcohol intake and burnout or depression risk, in contrast to De Oliveira *et al* who observed increases in both in US anaesthetic trainees who consumed ≥5 alcoholic drinks per week [4]. One in five respondents performed ≤1 hour of exercise each week, below the UK Department of Health recommendation of 150 minutes/week [37] and this was associated with a two-fold increase in high stress and high depression risk. While the role of exercise in

reducing stress, anxiety and depression is well established [38], interventional studies are required to assess whether modifying exercise behaviours can reduce perceived stress in anaesthetic trainees.

Respondents in all high risk groups were significantly more likely to complete the survey anonymously and were therefore less likely to take part in the confidential interview phase of the study [16]. This suggests that those in high risk groups were more reluctant to be identified and therefore may be more isolated and/or non-engaged with efforts to explore wellbeing issues. Recent research shows that UK doctors remain concerned about disclosure of mental ill-health and that younger doctors and trainees are the least likely to disclose these issues; key concerns relating to fear of being 'labelled', confidentiality and not understanding the support structures available [39]. Anaesthetic trainees at the highest risk of stress, burnout and/or depression may therefore be those least likely to seek help. Anaesthetic departments, postgraduate deaneries and regulators should ensure that appropriate support services are available for all anaesthetic trainees - and that these are clearly and frequently signposted- and should work to reduce the stigma associated with help-seeking behaviour for mental ill-health.

This study has recognised limitations. We surveyed a wide cross-section of junior anaesthetists from three regions in the UK. However, due to social, economic and training programme variation, findings might differ in other regions. The response rate was 64% which, although comparing favourably with recent national surveys of anaesthetic trainees' morale and welfare [12] and fatigue [13], raises the possibility of responder bias. However, the age and gender distribution in our sample was well matched to demographic data held by Schools of Anaesthesia. Additionally, every eligible anaesthetic department contributed to the study and full data sets were returned in every case. Our survey relied on self-reported data, which may not represent actual behaviours; respondents were not asked to keep work, alcohol consumption or exercise diaries. Finally, we evaluated a range of variables with existing evidence to suggest associations or correlations with the development of stress, burnout, depression, and/or low work-satisfaction. Other factors - ethnicity, family-support, substance-misuse or other stressors - could be also be important.

High perceived stress, high burnout risk, high depression risk and low work-satisfaction are common and frequently co-exist amongst anaesthetic trainees and non-training grade junior anaesthetists in the South West of England and Wales. This represents a concern for these doctors, the patients they treat, and their employers, trainers and managers. Having no children, >3 days of sickness absence in the previous year, $\leq$1 hour/week of exercise and >7.5hrs/week of additional non-clinical work were independently predictive of negative psychological outcomes. Although female gender was associated with high stress, high burnout risk was more likely in male respondents. This information could help in the identification of at-risk groups, as well as informing ways to support these groups and influence resource and intervention design. Targeted

interventions, such as modification of exercise behaviour and methods of reducing stressors relating to non-clinical workloads, warrant further research.

Competing interests

The authors declare that they have no competing interests.

Acknowledgements

We would like to thank all anaesthetic trainees and non-training grade junior anaesthetists who contributed to this study. We also thank the Trainee Research Networks of the Severn (STAR), Peninsula (SWARM) and Wales (WAAREN) Deaneries for their support. The work was funded by a joint grant from the Association of Anaesthetists of Great Britain & Ireland (AAGBI) and National Institute for Academic Anaesthesia (NIAA). We are incredibly grateful for this support, which has enabled us to perform this research.

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Box 1. Psychological screening tests administered in the survey.

Psychological stress (Perceived Stress Scale; PSS-10) - Ten items designed to measure the degree to which situations in one's life are appraised as stressful. A score is generated based on a frequency scale, with ≥20 indicating high perceived stress [17].

Burnout risk (abbreviated Maslach Burnout Inventory – Human Services Survey; aMBI-HSS) - Nine questions assessing the three subcategories of personal accomplishment, depersonalisation and emotional exhaustion and accounting for frequency of symptoms. Each subcategory has criteria for identifying high or low risk. A high overall risk of burnout is defined by a high burnout score in two or more of the subcategories [18, 19].

Depression risk (Harvard National Depression Screening Day Scale; HANDS) - Ten questions identifying depressive symptoms and accounting for their frequency. A score between 0-30 is generated with a score >9 being consistent with a major depressive episode [20].

Work-satisfaction (Effort-Reward Imbalance scale; ERI) – 16 items to assess the degree of professional satisfaction and work distress. The scale includes three items measuring Effort, seven items measuring Reward and six further items measuring Over-Commitment. Scores are generated from an agreement scale, scored: 1 (strongly disagree) to 4 (strongly agree). An imbalance is experienced if, for example, an extraordinary effort at work does not receive adequate rewards. An Effort-Reward (ER) ratio can be calculated, where an ER-ratio of >1.0 indicates an imbalance in effort and reward [21].

Table 1. Additional non-clinical weekly activity. Data are presented median (IQR [range]).

Non-clinical activity	**Hours; median (IQR [range])**
Emails and administration	1.0 (1.0-2.5 [0.0-9.0])
Rota-writing/other management	0.0 (0.0-0.5 [0.0-9.0])
Audit/Research/Presentations	1.0 (0.5-2.25 [0.0-9.0])
Revision/exam preparation (all respondents)	0.5 (0.0-3.75 [0.0-9.0])
Revision/exam preparation (if currently revising i.e. >30mins/week)	5.25 (2.25-9.0 [0.0-9.0])
ePortfolio maintenance	1.0 (0.5-1.0 [0.0-9.0])
Other	0.0 (0.0-1.0[0.0-9.0])
Total	**7.5 (4.5-11.75 [0.0-41.0])**

Table 2. Prevalence of high perceived stress, high burnout risk, high depression risk, and professional effort-reward imbalance amongst 397 anaesthetic trainees. Data are presented as number (proportion) [95% CI], mean (SD) and median (IQR [range]).

Measure	**Perceived Stress (PSS-10)**	**Burnout (aMBI-HSS)**	**Depression (HANDS)**	**Work satisfaction (ERI)**
Risk Category	High perceived stress 147 (37.0%) [32.2 - 41.9]	High risk of burnout 98 (24.7%) [20.5 – 29.2]	High risk of depression 73 (18.4%) [14.7 – 22.5])	Effort-Reward Imbalance >1.0 190 (47.9%) [42.7 – 52.8]
Mean score (SD)	17.5 (6.1)	Personal accomplishment: 13.1 (3.0) Depersonalisation: 4.3 (4.1) Emotional exhaustion: 8.1 (3.7)	5.9 (4.7)	Effort: 8.3 (1.7) Reward: 19.1 (3.2) ER-ratio 1.1 (0.4)
Median score (IQR [range])	18 (14-22) [0-37]	Personal accomplishment: 13 (11-15 [2-18]) Depersonalisation: 3 (1-7 [0-18]) Emotional exhaustion: 8 (5-11 [0-18])	5 (2-9 [0-28])	Effort: 8 (7-9 [3-12]) Reward: 19 (17-21 [7-28]) ER-ratio 1.0 (0.82-1.23 [0.28-3.99])

PSS-10 - Perceived Stress Scale; aMBI-HSS: abbreviated Maslach Burnout Inventory – Human Services Survey; HANDS - Harvard National Depression Screening Day Scale; HANDS and ERI - Effort-Reward Imbalance scale (see Appendix 1).

Figure 1. Euler diagram displaying proportion of all respondents categorised with high perceived stress, high burnout risk and high depression risk, and the co-existence of these issues.

Table 3. Demographic characteristics of respondents categorised by perceived stress, burnout risk, depression risk and work-satisfaction. Data are presented as number (proportion of row). Univariate analysis using Fisher exact test (* $p < 0.05$)

Variable	Overall	Burnout risk			Depression risk			Perceived Stress			Work Satisfaction		
		Low	High	p value	Low	High	p value	Low	High	p value	Low	High	p value
Age													
≤30	144 (36)	99 (69)	45 (31)	0.029*	116 (81)	28 (19)	0.69	88 (41)	56 (39)	0.59	27 (19)	117 (81)	0.04*
>30	253 (64)	200 (79)	53 (21)		208 (82)	45 (18)		162 (44)	91 (36)		71 (28)	182 (72)	
Gender													
Male	206 (52)	149 (72)	57 (28)	0.16	174 (84)	32 (16)	0.15	149 (72)	57 (28)	0.0001*	51 (25)	155 (75)	1.0
Female	191 (48)	150 (79)	41 (21)		150 (79)	41 (21)		101 (53)	90 (47)		47 (25)	144 (75)	
Marital status													
Married	176 (44)	142 (81)	34 (19)	0.035*	157 (89)	19 (11)	0.0006*	117 (66)	59 (34)	0.21	42 (24)	134 (76)	0.81
Not married	221 (56)	157 (71)	64 (29)		167 (76)	54 (24)		133 (60)	88 (40)		56 (25)	165 (75)	
Parenthood status													
Yes	132 (33)	108 (82)	24 (18)	0.036*	119 (90)	13 (10)	0.0016*	89 (67)	43 (33)	0.23	30 (23)	102 (77)	0.54
No	265 (67)	191 (72)	74 (28)		205 (77)	60 (23)		161 (61)	104 (39)		68 (25)	197 (75)	
Participation with Interviews													
Provided contact information	209 (53)	180 (86)	29 (14)	<0.00001*	201 (96)	8 (4)	<0.00001*	203 (97)	6 (3)	<0.00001*	34 (16)	175 (84)	<0.00001*
Remained anonymous	188 (47)	119 (63)	69 (37)		123 (65)	65 (35)		47 (25)	141 (75)		64 (34)	124 (66)	

Table 4. Lifestyle-related behaviour characteristics of respondents categorised by perceived stress, burnout risk, depression risk and work-satisfaction. Data are presented as number (proportion of row). Univariate analysis using Fisher exact test (* $p < 0.05$)

Variable	Overall	Burnout risk			Depression risk			Perceived Stress			Work Satisfaction		
		Low	High	p value	Low	High	p value	Low	High	p value	Low	High	p value
Smoking status													
Yes	9 (2)	7 (78)	2 (22)	1.0	9 (100)	0 (0)	0.38	8 (89)	1 (11)	0.29	3 (33)	6 (67)	0.69
No	388 (98)	292 (75)	96 (25)		315 (81)	73 (19)		270 (70)	118 (30)		95 (24)	293 (76)	
Weekly alcohol													
≤14 units	325 (82)	243 (75)	82 (25)	0.65	265 (82)	60 (18)	1.0	227 (70)	98 (30)	1.0	75 (23)	250 (77)	0.13
>14 units	72 (18)	56 (78)	16 (22)		59 (82)	13 (18)		51 (71)	21 (29)		23 (32)	49 (68)	
Weekly exercise													
≤ 1 hour	72 (18)	49 (68)	23 (32)	0.13	53 (74)	19 (26)	0.064	40 (56)	32 (44)	0.004*	17 (24)	55 (76)	0.88
> 1 hour	325 (82)	250 (77)	75 (23)		271 (83)	54 (17)		238 (73)	87 (22)		81 (25)	244 (75)	

Variable	Overall	Burnout risk			Depression risk			Perceived Stress			Work Satisfaction		
		Low	High	p value	Low	High	p value	Low	High	p value	Low	High	p value
Less Than Full Time													
Yes	52 (13)	44 (85)	8 (15)	0.12	44 (85)	8 (15)	0.70	31 (60)	21(40)	0.64	16 (31)	36 (69)	0.30
No	345 (87)	255 (74)	90 (26)		280 (81)	65 (19)		219 (63)	126 (37)		82 (24)	263 (76)	
Training Grade													
Specialty trainee	343 (86)	254 (74)	89 (26)	0.17	277 (81)	66 (19)	0.35	208 (61)	135 (39)	0.015*	84 (24)	25 (76)	0.87
Non-training grade	54 (14)	45 (83)	9 (17)		47 (87)	7 (13)		42 (78)	12 (22)		14 (26)	40 (74)	
Examination attempts for each successful stage													
1	155 (53)	116 (75)	39 (25)	0.08	133 (86)	22 (14)	0.13	106 (68)	49 (32)	0.22	32 (21)	123 (79)	0.059
>1	137 (47)	114 (83)	23 (17)		108 (79)	29 (21)		84 (61)	53 (39)		42 (31)	95 (69)	
Sickness absence in previous 12 months													
≤ 3 days	325 (82)	251 (77)	74 (23)	0.07	271 (83)	54 (17)	0.064	208 (64)	117 (36)	0.41	76 (23)	249 (77)	0.22
>3 days	72 (18)	48 (67)	24 (33)		53 (74)	19 (26)		42 (58)	30 (42)		22 (31)	50 (69)	
Additional non-clinical work													
≤ 7.5hr /week	197 (50)	157 (80)	40 (20)	0.048*	170 (86)	27 (14)	0.019*	145 (74)	52 (26)	<0.0001*	37 (19)	160 (81)	0.0075*
> 7.5hr /week	200 (50)	142 (71)	58 (29)		154 (77)	46 (23)		105 (52)	95 (48)		61 (31)	139 (69)	
Revision/exam preparation													
None	194 (49)	157 (81)	37 (19)	0.014*	168 (87)	26 (13)	0.014*	128 (66)	66 (34)	0.25	45 (23)	149 (77)	0.56
Revising	203 (51)	142 (70)	61 (30)		156 (77)	47 (23)		122 (60)	81 (40)		53 (26)	150 (74)	

Table 5. Anaesthesia training characteristics of respondents categorised by perceived stress, burnout risk, depression risk and work-satisfaction. Data are presented as number (proportion of row). Univariate analysis using Fisher exact test (* $p < 0.05$)

(>30 minutes/week)													

Table 6. Binary logistic regression models for high perceived stress, high burnout risk and high depression risk.

High Perceived Stress (PSS-10 score ≥20)				
Model	β	Odds Ratio [95% CI]	T	p value
Gender: female	0.80	2.23 [1.45-3.42]	13.33	<0.0001
Weekly exercise: ≤1hr	0.70	2.01 [1.18-3.44]	6.56	0.010
Additional non-clinical work: >7.5hr/week	0.62	1.87 [1.22-2.87]	8.13	0.004
(Constant)	-0.78	0.46	14.45	<0.0001
High Burnout Risk (high subscale scores in ≥2 aMBI-HSS subscales)				
Model	β	Odds Ratio [95% CI]	T	p value
Sickness absence previous 12 months: ≤3 days	0.71	2.03 [1.14-3.61]	5.79	0.016
Parenthood status: no	0.69	1.98 [1.16-3.38]	6.33	0.012
Gender: male	0.47	1.59 [1.00-2.57]	3.69	0.055
(Constant)	-0.82	0.44	6.33	0.012
High Depression Risk (HANDS score >9)				
Model	β	Odds Ratio [95% CI]	T	p value
Parenthood status: no	1.15	3.16 [1.63-6.12]	11.65	0.001
Weekly exercise: ≤1hr	0.69	1.99 [1.06-3.73]	4.62	0.032
Sickness absence previous 12 months: ≤ 3 days	0.69	1.99 [1.06-3.73]	4.62	0.032
(Constant)	-1.93	0.15	25.58	<0.0001

CI - Confidence Interval; PSS-10 – Perceived Stress Scale; aMBI-HSS - abbreviated Maslach Burnout Inventory – Human Services Survey; HANDS - Harvard National Depression Screening Day Scale

(see Appendix 1).

Appendix 1

Survey contents

1. Demographic, lifestyle-related behaviour and anaesthetic training data

The first section of the survey comprised 40 questions designed to capture demographic, social, health-behaviour and anaesthetic training data: age, gender, marital status, parenthood status, Deanery, stage of training, full time vs less than full time training, additional subspecialty training, number of anaesthetic specialist examination attempts, smoking status, weekly alcohol consumption, weekly exercise habits, number of sick days in the last year and time spent on non-clinical work outside of contracted hours within the last week.

2. Perceived stress; Cohen Perceived Stress Scale (PSS-10)

This section comprised the ten items from Cohen's Perceived Stress Scale (PSS-10) designed to measure the degree to which situations in one's life are appraised as stressful. PSS-10 possesses substantial reliability and validity and is the most widely used measure assessing perceived stress across a variety of populations [17]. A score is generated based on a frequency scale of 0 (never) to 4 (very often) in response to questions such as "In the past month, how often have you found that you could not cope with all the things you had to do?" A score of ≥20 indicates high perceived stress.

3. Burnout; abbreviated Maslach Burnout Inventory – Human Services Survey (aMBI-HSS)

This section consisted of all nine questions from abbreviated Maslach Burnout Inventory – Human Services Survey (aMBI-HSS) with three further items assessing professional satisfaction. The full MBI-HSS involves 22 questions: eight assessing personal accomplishment, five assessing depersonalisation, and nine for emotional exhaustion [18]. A score is given to each part of the MBI-HSS based on a frequency scale of 0 'never' to 6 'every day'. The survey evaluates personal accomplishment using questions such as "I feel exhilarated after working closely with my patients", depersonalisation using questions such as "I don't really care what happens to some patients" and emotional exhaustion using questions such as "I feel emotionally drained from my work". The MBI-HSS was shortened to nine items by McManus and colleagues to include three items assessing personal accomplishment, depersonalisation and emotional exhaustion [19]. The risk ranges of the subgroup scores for the nine-item MBI are proportionally derived from the full MBI as follows: personal accomplishment, 0-12 (high risk), 13-14 (moderate risk), ≥15 (low risk); depersonalisation, 0-3 (low risk), 4-6 (moderate risk), ≥7 (high risk); emotional exhaustion, 0-6 (low risk), 7-10 (moderate risk), ≥11 (high risk). A high overall risk of burnout was defined as a respondent with high burnout subscale scores in two or

more of the subscales. The nine item aMBI-HSS has been shown to be highly correlated with the original subscales and display high convergent and discriminant validity making it a valid and reliable proxy for the full version [Supplementary ref 1].

4. Depression; Harvard National Depression Screening Day Scale (HANDS)

This section included all ten questions of the Harvard National Depression Screening Day Scale (HANDS) to evaluate depression [20]. The questions are based on a four-point frequency scale (none, some, most or all of the time). Examples of questions include: "Over the past two weeks, how often have you been feeling low in energy, slowed down?" and "Over the past two weeks how often have you thought about of wanted to commit suicide?" A score between 0-30 is generated with a score >9 being consistent with a major depressive episode. The ten-item HANDS scale has good internal consistency and validity: a cut-point score of ≥9 provides a sensitivity of >0.95 and specificity of 0.6; performing at least as well the 20-item Zung Scale, the 21-item Beck Depression Inventory-II and the 15-item Hopkins Symptom Depression Checklist but with the advantage of a briefer administration time [20].

5. Professional satisfaction; Effort-Reward Imbalance questionnaire (ERI)

This section was composed of all 16 items of the Effort-Reward Imbalance (ERI) questionnaire (short version) which is designed to assess the degree of professional satisfaction and has been shown to have discriminant validity and reliability [21]. The foundations of the model are the contractual working conditions, which are based on the norm of social reciprocity. An imbalance is experienced if, for example, an extraordinary effort at work does not receive adequate rewards. Occupational rewards include money, esteem and recognition, career prospects, and job security [Supplementary ref 2]. The scale includes three items measuring Effort, seven items measuring Reward and six items measuring Over-Commitment. Scores are generated from an agreement scale, scored: 1 (strongly disagree) to 4 (strongly agree). An Effort-Reward (ER) ratio can be calculated - using a correction factor to adjust for the unequal number of items - where an ER ratio of <1 indicates less effort for each reward and >1 indicates more effort for each reward. Although ER ratios of >1 indicate low work-satisfaction, the ERI scale creators recommend that, when considering dichotomous outcomes, it is preferable to define the upper quartile of ranked ER-ratios as a threshold with clinical significance [Supplementary ref 3] - this is the approach which we applied in this study.

Supplementary references

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2. Siegrist J. Adverse health effects of high effort - low reward conditions at work. *Journal of Occupational Health Psychology* 1996; **1**: 27–41.

3. Siegrist J, Starke D, Chandola T, et al. The measurement of effort–reward imbalance at work: European comparisons. *Social Science & Medicine* 2004; **58**: 1483–99.